

13TH ANCAP SYMPOSIUM TENTATIVE PROGRAMME
DAY 1: Tuesday, 22nd December 2020

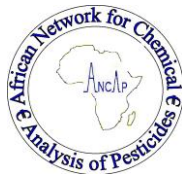
Time EAT (GMT +3)	Activity
11.00 – 11.30	Preliminaries and Welcoming Remarks
	SESSION I: Chair –
11.30 - 12.00	Lecture 01 (Plenary): Mmochi – ANCAP Report
12.00 - 12.20	Lecture 02: Nantaba
12.20 - 12.40	Lecture 03: Mwakalapa
12.20 – 13.00	Lecture 04: Tidings
13.00 - 13.30	Health Break
13.30 -13.50	Lecture 05 : Zaranyika
13.50 -14.10	Lecture 06: Nagawa
14.10 - 14.40	Lecture 07: Dzomba
14.40 - 15.00	Lecture 08: Said
15.20 - 15.40	Lecture 09: Ali
15.40 - 16.00	Lecture 10: Adam Emad
16.00 - 16.30	Health Break
16.30 – 16.50	Lecture 11: Muhizi
16.50 – 17.10	Lecture 12: Sibosiko
17.10 – 17.30	Lecture 13: Olukanni
17.30 – 17.50	Lecture 14: Onuegbu
17-50 – 18.10	Lecture 15: Olaniran

DAY 2: Wednesday, 23rd December 2020

Time EAT (GMT +3)	Activity
	SESSION II: Chair –
11.00 – 11.30	Lecture 16 (Plenary): Madadi
11.30 – 11.50	Lecture 17: Abong'o
11.50 – 12.10	Lecture 18: Momany
12.10 – 12.40	Lecture 19: Welimo
12.40 – 13.00	Lecture 20: Mohamed
13.00 – 13.30	Health Break
13.30 -13.50	Lecture 21 (Plenary): MMochi
13.50 -14.10	Lecture 22: Aloo
14.10 – 14.40	Lecture 23: Tongu
14.40 – 15.00	Lecture 24: Abdelrahman
15.20 – 15.40	Lecture 25 Jacob:
15.40 – 16.00	Lecture 26: Abdala
16.00 – 16.30	Health Break
16.30 – 16.50	Lecture 27: Sha'Ato
16.50 – 17.10	Lecture 28: Ibrahim
17.10 – 17.30	Lecture 29: Eltohami
17.30 – 17.50	Lecture 30: Lukato
17.50 – 18.10	Lecture 31: Alias
	Lecture 32: Adam Mohamed
	Lecture 33: Kipter
	Lecture 34: Kiyoko
	Closing Remarks

**THE AFRICAN NETWORK FOR CHEMICAL ANALYSIS OF PESTICIDES
AND OTHER POLLUTANTS
(ANCAP)**

The Thirteenth ANCAP Symposium



**Virtual Symposium organized from Dar es Salaam, Tanzania
22nd - 23rd December 2020**

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	Closing Remarks

ABSTRACTS

L01

ANCAP Progress Report for 2019

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ANCAP Executive Secretary
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P. O. Box 668
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ABSTRACT

The African Network for Chemical Analysis of Pesticides and other pollutants (ANCAP) is a legally registered non-governmental, non-political, non-sectarian and non-profit making scientific body devoted to study, promote and develop the science of all aspects of chemical analysis of pesticides and other pollutants, including residues, degradation and environmental fate - with the overall goal of safeguarding public health and the environment, ensuring safety of African agricultural and aquatic products in order to make them competitive in the world market, thereby significantly contributing to the continent's poverty eradication endeavours. The overall objective is to increase the contribution by ANCAP in research and higher education in basic sciences to sectors important for local and global development.

In 2019, on objective one, nine students from member countries were supported by ANCAP to attend ANCAP symposium. Also, a record 54 out of the targeted 57 were published mainly in the areas of pesticides and POPs, heavy metals, bioremediation, water pollution and pollution general and two PhD, and 1 MSc students completed where the 2PhDs were males. Furthermore, a record fifty four publications were done in peer reviewed journals compared to the targeted 57 publication. Moreover, 27 presentation were done, 23 in ANCAP symposium and four in different fora and one TV program was made. Of the 4 presentations, 3 were invited speakers

On objective 2, the Executive Secretary communicated with 3 scientists from Norway and 4 ANCAP members to attend the Marie Sklodowska Curie European Union Meeting to discuss collaborative proposal writing. Furthermore, the Executive secretary travelled to Norway in June 2019 to attend a Viva Voce Meeting of an ANCAP students who graduated and discussed future collaboration with Norwegian University of Life Sciences under the auspices of Training and Research in Aquatic Health in the Eastern and Southern Africa Furthermore, the executive secretary was invited to travel Norway from 23rd and return on the 29th September 2019 to discuss a joint project on Anthropology and Toxicology (AnthroTox) that is taking place between the Institute of Marine Sciences. He also participated in a public debate as part of the Norwegian Research Council's Research Day in 2019, focusing on the Environment. Moreover, the executive secretary was invited to attend the a TRAHESA project extensions discussion meeting and attend a policy brief seminar in Norwegian University of Life Sciences on 17th and 18th October, 2019

On objective 3 ANCAP has this far managed to have proper accounting and did not have a bad reporting of accounts to the ANCAP board as well as to the donors while on objective 4 ANCAP has not been able to get any training or academic support from a donor other than IPICS although it has good in-kind support from the home intuitions, but this year a project proposal entitled "Development of common protocols for sampling and analysis of organic pollutants and heavy metals and its use for studying chemical pollutants in Sub-Saharan Africa" was submitted to

Temporal dynamics and ecotoxicological risk assessment of personal care products, phthalate ester plasticizers, and organophosphorus flame retardants in water from Lake Victoria, Uganda

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ABSTRACT

For the first time the occurrence of 25 organic micropollutants (OMPs) including; 11 personal care products (PCPs), six phthalate ester plasticizers (PEPs) and eight organophosphorus flame retardants (OPFRs) was investigated in 72 water samples obtained from five Bays in the Uganda sector of Lake Victoria. In addition, an assessment of the potential ecotoxic risk of the target OMPs to aquatic organisms was conducted. Water samples were analysed for the target OMPs using gas chromatography coupled with mass spectrometry (GC/MS). All the target PCPs were found in all the water samples with the exception of musk ketone and 2,6-di-*tert*-butylphenol. Triclosan (89-1400 ng L⁻¹), benzophenone (36-1300 ng L⁻¹), and 4-methylbenzylidene camphor (21-1500 ng L⁻¹) were the most predominant PCPs. All the six plasticizers were found in all the water samples with dibutyl phthalate (350-16 000 ng L⁻¹), and *bis*-(2-ethylhexyl) phthalate (210-23000 ng L⁻¹) being detected in highest concentrations. Five OPFRs out of the eight targeted were found in all the water samples. Tricresyl phosphate (25-8100 ng L⁻¹), *tris*-(2-chloroethyl) phosphate (24-6500 ng L⁻¹) and triphenyl phosphate (54-4300 ng L⁻¹) were the most dominant OPFRs. The highest concentrations of OMPs were recorded in Murchison and Thurston Bays, presumably due to industrial wastewater effluents from the highly industrialized localities of the two Bays. Ecotoxicological risk assessment showed that PCPs (triclosan, musk ketone, and 4-MBC), plasticizers (dibutyl phthalate, *bis*-(2-ethylhexyl) adipate and *bis*-(2-ethylhexyl) phthalate) and OPFRs (tricresyl phosphate, triphenyl phosphate and *tris*-(2-chloroethyl) phosphate) pose a high ecotoxic risk to lives of aquatic organisms (risk quotients, RQ >1).

Occurrence and levels of persistent organic pollutants (POPs) in farmed and wild marine fish from Tanzania. A pilot study.

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- a. Department of Food Safety and Infection Biology, Norwegian University of Life Sciences, P. O. Box 8146 Dep, N-0033 Oslo, Norway
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- c. Department of Veterinary Medicine and Public Health, Sokoine University of Agriculture, P. O. Box 3021, Morogoro, Tanzania
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ABSTRACT

In 2016, farmed and wild milkfish (*Chanos chanos*) and mullet (*Mugil cephalus*) from Tanzania mainland (Mtwara) and Zanzibar islands (Pemba and Unguja) were collected for analyses of persistent organic pollutants (POPs). Fish livers were analysed for organochlorine pesticides (OCPs), polychlorinated biphenyls (PCBs), brominated flame retardants (BFRs). Muscle tissue was used for analyses of perfluoroalkyl substances (PFASs). The major contaminant was p,p 0-DDE. The highest p,p 0-DDE concentration was found in wild milkfish from Mtwara (715.27 ng/g lipid weight (lw)). This was 572 times higher than the maximum level detected in farmed milkfish from the same area. The ratios of p,p0-DDE/p,p0- DDT in wild milkfish and mullet from Mtwara and Pemba indicate historical use of DDT. In contrast, ratios in farmed milkfish from Unguja and Mtwara, suggest recent use. The levels of HCB, HCHs and trans-nonachlor were low. P10PCBs levels were low, ranging from -180> -138. PBDEs were detected in low and varying levels in all locations. BDE-47 was the dominating congener, and the highest level was found in farmed milkfish from Jozani (1.55 ng/g lw). HBCDD was only detected in wild mullet from Pemba at a level of 16.93 ng/g lw. PFAS was not detected in any of the samples. POP levels differed between geographic areas and between farmed and wild fish. Human activities seem to influence levels on PCBs and PBDEs on Unguja.

Keywords: Persistent organic pollutants (POPs); DDTs; Aquaculture; Milkfish; Mulletts; Tanzania

Human health risk assessment and level of exposure to bisphenol A in the city of Harare hot spots

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ABSTRACT

Bisphenol A (BPA) is a persistent organic pollutant of environmental concern. It is an endocrine regulator and disrupter with several adverse effects on humans including hormone dependent cancers, obesity, infertility, aggressive behaviour, and early onset of puberty. Thus this study assessed levels of human exposure to BPA in the city of Harare hot spots. Samples were collected in January–March of 2019. The BPA was extracted by liquid-liquid extraction using dichloromethane from bottled water, tap water, borehole water and toys. Solid phase extraction was conducted on surface water as well as soil using C-18 sorbents. The levels of BPA were determined using gas chromatography coupled to flame ionization detector using a calibration method. Bisphenol was observed in all samples in low to high levels showing that there is human exposure to it. The average concentration of BPA was 0.0776 ppm and 0.0040 ppm for outdoor bottled water and indoor bottled water respectively. Outdoor bottled water for all the brands showed higher levels of BPA concentrations. Tap and borehole water average levels were 0.0084 ppm and 0.0726 ppm. Levels in thermal paper was 0.2778 ppm while in baby toys and drinking bottles was < 0.01 ppm. The levels of direct exposure were below the no observed adverse effect level (NOAEL) at 5 mg/kg bw/day. The BPA levels was found to be significantly higher than the maximum permissible safety levels for Pomona dumpsite (0.3361 ppm) and Mukuvisi River (316.994ppm). The results show that people in the city of Harare are directly exposed to low and indirectly high levels of bisphenol. Thus efforts should be made to reduce products consisting of Bisphenol since even low levels are considered to be a potential danger to humans.

The term bioavailability; current and proposed definition: insights from persistence of tetracyclines antibiotics in the aquatic environment

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ABSTRACT

Depending on the aquatic bioavailability of the antibiotics, the presence of these antibiotics in the aquatic environment can lead to adverse effects to fish, birds, crocodiles, as well as domestic animals. Of particular concern is the possible development of resistance to the drugs. The bioavailability of organic substances in the aquatic and soil environments depends on the target organism, as well as the nature of the substance and its speciation form. The term bioavailability derives from pharmacology, where it is defined as the fraction of administered dose of unchanged drug (i.e., parent compound) that reaches the systematic circulation. With reference to its usage in Ecotoxicology, it is defined as the amount of chemical that is actually taken up from the environment and is available to cause a biological response. More succinct definitions of bioavailability were proposed by Semple et al. (2004), who defined “a bioavailable substance as one that is freely available to cross an organism’s cellular membrane from the medium the organism inhabits at a given time”, and “a bioavailable substance as one that is available to cross an organism’s cellular membrane from the environment, if the organism has access to the chemical”. It is apparent from these definitions that bioavailability depends on the target organism, as well as the nature of the substance and its speciation form. The definitions of bioavailability of organic substances to fish, birds and other higher animals must take into account the fact that fish, birds and other higher animals actually drink the water, so that substance adsorbed to non-settling colloidal particles in the water phase should also be regarded as being accessible to these species. In addition, organic compounds introduced into the aquatic environment escape into the air above the water column, and become bioaccessible to higher fauna through inhalation. Thus bioaccessibility to fish, birds and other animals can be defined as the fraction of the substance in the water phase, C_w , plus the concentration of the substance in air above the water column, C_{air} , over the mean concentration of the substance in a given aquatic system.

L06

The Occurrence of Selected Antibiotics in Fish and Benthic Invertebrates (*Oligochaete*) From Lake Victoria, Uganda

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ABSTRACT

In this paper, the occurrence of selected active antibiotic ingredients in fish and benthic invertebrates from the Murchison Bay of Lake Victoria is presented. The compounds were extracted from fish tissue and worms using solid phase extraction (SPE) and analyzed using liquid chromatography-tandem mass spectrometry (LC-MS/MS). A total of ten antibiotics were detected, with chloramphenicol and tetracycline being the most frequently detected analytes. The total (Σ) concentrations of selected antibiotics in fish samples ranged from 0.60491825 μ g/L to 32.86085 μ g/L while in worms they varied from 0.90933125 μ g/L to 73.07155 μ g/L. Some Antibiotics have been detected with greater frequency in fish than in worms, and others vice versa. The study has shown that sulfamethoxazole, levofloxacin chloramphenicol were the most frequently detected antibiotics. Aquaculture activities, ambient wastewater discharge and runoff from farming have been singled out as the major sources of antibiotics into the lake.

L07

Kinetic and statistical thermodynamic analysis of the degradation of tetracycline hydrochloride in the aquatic environment under sub-tropical Conditions

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ABSTRACT

The present study reports kinetic and statistical thermodynamic analysis of tetracycline hydrochloride (TC) degradation using the multiphasic pseudo zero order analysis for the first time. The degradation was studied using microcosm experiments by monitoring changes in concentration over a 90 day period using HPLC. Concentration changes were monitored both in the water and sediment phase. Using the multiphasic zero order kinetic model the life-times of the speciation forms, thermodynamic parameters, ΔG_{ads} , ΔH_{ads} and ΔS were estimated. The degradation data shows that TC degrades faster in the sediment than in the water phase with life-times of 9.7, 19.7, 142.7 and 26.9, 36.8, 238.1 days respectively for free and adsorbed forms. The free TC in the water phase and pore water degraded faster with life-times of 26.9 days and 9.7 respectively than the adsorbed TC. Basing on the calculated ΔG_{ads} values, -1.85-14.23 KJ adsorption to the colloidal and sediment particle is thermodynamically feasible and shows existence of an adsorption-

desorption hysteresis between the adsorbed and desorbed tetracycline molecules. For the adsorption of TC onto colloidal and sediment particles the thermodynamics analysis also implies an enthalpy driven adsorption which involves physisorption.

L08

Isolation of the *Tephrosia vogelii* extract and rotenoids and their toxicity in the RTgill-W1 trout cell line and in zebrafish embryos

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ABSTRACT

This study focused on identifying the rotenoids from the *Tephrosia vogelii* plant (fish-poison-bean), investigating the toxic potency of a crude *T. vogelii* extract and individual rotenoids (tephrosin, deguelin and rotenone) in vitro and in vivo and assessing the mode of action. A trout (*Onychorhynchus mykiss*) gill epithelial cell line (RTgill-W1) was used to determine the cytotoxicity of rotenoids and effects on cell metabolism. Zebrafish (*Danio rerio*) aged from 3 hours post fertilization (hpf) to 72 hpf were used for testing the developmental toxicity. The crude *T. vogelii* plant extract significantly decreased the cellular metabolic activity and was cytotoxic at lower concentrations (5 and 10 nM, respectively), while tephrosin, deguelin and rotenone showed these effects at concentrations ≥ 50 nM. The embryo toxicity test showed a higher sensitivity to rotenoids, whereby the crude *T. Vogelii* extract had the highest toxic potency and induced adverse health effects including deformities and mortality at the lowest concentration (5 nM) compared to rotenone (10 nM) and deguelin and tephrosin (50 nM). These results indicate that the crude *T. Vogelii* extracts are highly potent and the bioactivity of these extracts warrant further investigation for their potential use to treat parasites in human and veterinary medicine and as a natural alternative to pesticides.

Key words: *T. vogelii*; rotenoids; cell-culture; gill; trout; zebrafish.

Insecticidal effect of citronella oil nanoemulsions against *Spodoptra litura* (Fab)

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ABSTRACT

The preparation protocol for development of nanoemulsion formulation of citronella oil was developed. The developed nanoemulsion formulations are stable as per CIPAC guidelines and the sizes of micelle were in nano range, confirmed through analysis using DLS and TEM. The loading of citronella oil in the nanomicelle was confirmed using FT-IR, which shows characteristic bands of both the oils in the nanomicelle. These formulations have been evaluated for their bioactivity against 3rd instars of *Spodoptera litura* (Fab) in laboratory conditions. Results showed that increased concentration of neem oil in the nanoemulsion resulted in enhanced insect growth regulatory activity. The citronella nanoemulsion formulations have been evaluated for their larvicidal and growth regulatory activity against 3rd instar of *Spodoptera litura* (Fab) in laboratory conditions. Maximum (73.33%) larval mortality occurred in CNE-8, CNE-9 and CNE-10 after 72 hrs. CNE-10 showed the highest larval weight reduction 97.67% at 2.0% concentration 72 hrs. Developed nanoemulsions, based on citronella oil and neem oil, can be utilized as an alternative for the management of pests as these can be easily prepared and are economically viable and less toxic to the environment than synthetic pesticides.

Keyword: Nanoemulsion, Citronella oil, Neem oil, *Spodoptera litura*

Natural Anopheline Mosquito Repellents and Phytochemical Analysis of Ethanol and Hexane Leaf Extracts of Four Plants

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ABSTRACT:

Plant-based repellents have been used for generations in traditional practice as a personal protection measure against host-seeking mosquitoes. Control of mosquitoes is something of utmost importance in the present day with rising number of mosquito borne illnesses. Mosquito repellents could be one of the most effective tools for protecting humans from mosquito attack and from mosquito-borne diseases, each of the products used for mosquito control have varying degrees of effectiveness. Carbon dioxide and lactic acid present in sweat in warm-blooded animals act as an attractive substance for mosquitoes. The perception of the odor is through chemo-receptors present in the antennae of mosquitoes. Insect repellents work by masking human scent; a number of natural and chemical mosquito repellents were studied. The main aim of this study is screen the phytochemicals and compares the mosquito repellent activities of essential oils from the ethanol and hexane leaf extracts of (*Ocimum basilicum* L.), Wild Thyme (*Coleus forskohlii* Briq), Kafure (*Eucalyptus camaldulensis* Dehnh.) and Lemongrass (*Cymbopogon flexuosus* Steud.) under laboratory conditions. Alkaloids, saponins, Flavonoids, terpens, tannins were present in all the 4 plant extracts. The extracts were formulated in pure fragrance free Vaseline jelly, The formulations tested were made into concentration of 50% and 100% for each plant (ethanol extracts, hexane extracts and mixture of two extracts). The result, showed that undiluted hexane leaves extract (100%) provided maximum CPT according to the follows: **228 min** wild thyme, **116 min** basil, **54 min** Lemongrass and **32 min** kafure, while the undiluted ethanol leaves extracts provided maximum CPT according to the follows: **182min** wild thyme, **43 min** basil, **33 min** kafure and **28 min** Lemongrass, thus the hexane extract seemed more stronger in repellency than the ethanolic extracts, and the *Coleus* is the best and effective as mosquitoes repellent than other plants, followed by Basil and Lemon grass and kafure, while DEET (lavenda) 94 min against *Anopheles gambiae*. Regarding the combination of the ethanol and hexane extracts the Wild Thyme 50% and 100% were recorded the highest protection time 182 and 215 min respectively compare to the other plant extracts. By the way the selected four plant extracts offered protection against *Anopheles arabiensis* adult female mosquitoes but varied in terms of repellency. The essential oils of *C. forskohlii* and *O. basilicum* leaf extracts have been confirmed to have potentials as mosquito repellent agents *Anopheles*. A chromatographic analysis of plant extracts (GC-MS) was carried and identified the chemical compounds of ethanol and hexane extracts and the terpens was major compounds appeared with several sesquiterpene compounds, thymol was aspect to repellency. According to the results, the further studies is required to those Extracts especially basil and Wild Thyme Extract for their effectiveness and the carrier for preparing best formulation. The other aspect of toxicity and field trial of those plants oils are needed.

Leachate Characterization and Assessment of Groundwater Pollution near Municipal Solid Waste: Case of Nduba Landfill

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Abstract

Nduba landfill is the only landfill in Kigali city where all wastes are being deposited nowadays. Wastes dumped in Nduba landfill increase at high rate as the years passes due to the population increase and economic development in Kigali city. This study has undertaken to assess the effect of leachate on groundwater from Nduba landfill. Two methodologies; Questionnaire survey and Laboratory analysis have been used through this study. Two samples were collected, groundwater and leachate samples for laboratory analysis. Groundwater sample was collected from Nyakagezi spring which is under the Nduba hill, in Nduba sector, Gatunga cell, Burungeri village. The parameters analyzed in both groundwater and leachate samples are; Hydrogen Potential(pH), Temperature, Electrical conductivity, Turbidity, Total Dissolved Solids, Total Suspended Solids, Total Alkalinity, Total Hardness, Calcium Hardness, Magnesium Hardness, Nitrate, Nitrite, Sulfate, Phosphate, Ammonia-Nitrogen and Iron. In groundwater sample; Turbidity (16NTU), Ammonia-Nitrogen (0.85mg/l), and Iron (0.46mg/l) results were obtained and they are above the accepted limit of drinking water quality standard. Nitrate gave the result which is under the accepted limit but its value in groundwater sample is nearly equal to the nitrate concentration in leachate sample. In leachate sample, the findings are above the accepted limit except Nitrate and Magnesium. Turbidity, Ammonia-Nitrogen, Iron and Nitrate values indicate the groundwater contamination as the result of runoff, leachate migration or percolation from Nduba landfill. Therefore, it recommended that Kigali city and other responsible authorities should implement the plan of designing sanitary landfill, and support further study to be conducted on other untested physico-chemical parameters, heavy metals and biological parameters in order to get more about leachate effect on groundwater, also treatment of groundwater around Nduba landfill should be done.

Keywords: Landfill, Environmental impacts, Groundwater pollution, Heavy metals, Leachate, and Solid waste disposal

L12

Nitrification Characterization of Nitrite to Nitrate for Nitrogen Removal and Nitrous Emission, A review

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ABSTRACT

Nitrate mainly originated by fertilizers and nitrification is essential pollutant of ground water and surface water. It has a big effect on human health and environment. The oxidation of ammonium and nitrite play a key role to generate nitrate. The nitrification process can be affected by several factors, leading to the formation of undesirable end products as NO_2 and N_2O . The fresh leachate collected and investigated has shown that $\text{NO}_3\text{-N}$ and $\text{NO}_2\text{-N}$ less than 0.1 mg/L, while the BOD5/TN ratio seems to be at risk for nitrous emission. In this study, the aerobic and anaerobic operation method has applied, the rate of nitrous during five days increased remarkably while from first day to third, the variation of curve was small. This research has shown that this can be achieved through inhibition of microbial activities responsible for N_2O emission.

Keywords: Nitrification, nitrate, nitrite, nitrogen, nitrous emission

L13

Determination of the Pesticides and Herbicides Residues and Their Degradation Products in Kura Irrigation Farmland Soils

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ABSTRACT

The toxicity of pesticides and herbicides in agricultural products to man is well known and has been a major challenge in the past years. Herein, we report the assessment of the pesticide and herbicide residues and their degradation products in Kura irrigation farmland soils in Kano, Nigeria. The analysis of soil samples obtained from rice farmland plots were carried out during the planting and after the harvesting periods to determine the residue levels and degradation products of the pesticides and herbicides used. The pesticide residue analysis was carried out using GC/MS after extraction with a mixture of n-hexane and acetone (1:1) in a soxhlet extractor. The soil samples were also analysed for pH and organic matter using standard analytical methods. It was observed that the residues extracted from the soil samples and the raw pesticide samples were not similar. This was attributed to degradation products of the raw pesticides used on the farms. Variations of several residues were determined because of the nature of active ingredients in the different brands of pesticides and herbicides employed to meet the demands of the farmers. Most compounds detected as residues include 1-octadecene, 9-heptadecanone, (E)-3-eicosene, (Z)-5-nonadecene, heptadecane, 1-docosene, 1-nonadecene, and 1-eicosene. The acidity and organic matter content of most of the soil samples increased slightly after harvest. Of the compounds

determined, 1-octadecene and (E)-3-eicosene were detected during planting and after the harvesting periods showing that those are the most persistent of the residues in the soil samples.

KEYWORDS: Pesticide, Herbicide, Residue, (E)-3-Eicosene and 1-Octadecene.

L14

Investigation on the effects of powdered *Khaya ivorensis* on some properties of coal briquette

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ABSTRACT

This study was aimed at investigating the effects 0%, 20%, 40%, 60%, 80% and 100(%) load of powdered *Khaya ivorensis* on proximate analysis, elemental analysis and calorific value of coal briquette and the results were compared with that of raw samples. Ignition and combustion properties were also determined using standard methods. The results showed that as the mass load of pulverized *Khaya ivorensis* increases. The results for pulverized coal and powdered *Khaya ivorensis* showed moisture content (%) 6.8 and 12.3: ash content (%) 16.8 and 1.73: volatile matter (%) 54.70 and 82.12: fixed carbon (%) 21.7 and 3.85: calorific value (kJ/kg) 19765.55 and 16084.44 and bulk density (g/cm³) 0.83 and 0.20 respectively. The results showed the presence of SiO₂, SO₃, K₂O, CaO, TiO₂, Cr₂O₃, Fe₂O₃ in the coal and *Khaya ivorensis*. The results of briquette analyses showed that porosity index, moisture content (%), volatile matter (%) increase with increase in mass load. The density (g/cm³), ash content (%), sulphur content (%) and ignition time (sec.) decrease with increase in mass load while there is variation in compressive strength (N/mm²), calorific value, burning rate (kg/s) and thermal efficiency (%) as mass load increase. There was no flame in colour of the flame was yellowish. In conclusion, it is observed from the results that powdered *Khaya ivorensis* enhanced the properties of coal briquette.

Keywords: *Khaya ivorensis*, proximate analysis, elemental analysis, calorific value and coal briquette

L15

Bioactivities of Plant extracts against Post –flowering Insect Pests of Cowpea (*Vigna unguiculata* L. Walp) and Their Effects on Fatty acid Contents

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ABSTRACT

Use of plant extracts as botanical insecticides in the protection of crops against field insect pests serves as means of protecting our environment from indiscriminate use of synthetic chemical insecticides. This experiment was conducted to investigate the effects of *Petiveria alliacea* and *Annona squamosa* and their mixtures against insect pests of cowpea and their impact on the fatty acid profile during 2017/2018 major planting seasons. Two synthetic insecticides (Lambdachlorothrin and Dirchlovour) and untreated plots were included in the treatments. Each treatment was replicated and arranged in Randomized complete block design. Data were collected on insect populations, pod damage, yield and fatty acid of the harvested grains was determined. The results show that the tested plant extracts proved effective in the control of the observed insect

pests but there was variation in the efficacy of the tested plant extracts against the studied insects, for instance single application of *P. allieacea* had the least insecticidal efficacy (12%) against flower beetle whereas higher insecticidal control was observed on *N. viridula* and *M. sjostedti* (74 and 45% respectively) compared with *A. squamosa*. However, the plant extract mixture and Dirchlovour were equally effective as the single application of the plant extracts in the control of the observed insect pests as well pod damage but none of the plant extract was effective as Lambdachyalothrin. However, the yield obtained from plant extracts treated plants was significantly the same as Dirchlovour but highest yield was observed from Lambdacyhalothrin treated plants (1.14 t/ha). Among different chemical compounds that were detected, Lambdachyalothrin treated grains had only one compound (Methyl palmitate) whereas plant extracts treated plants higher fatty acid compounds than synthetic treated and untreated grains.

Key words: Cowpea, *Petiveria allieacea*, *Annona squamosa*, Lambdachyalothrin, Dirchlovour

L16

Challenges and perspectives in addressing Persistent Organic Pollutants and Atmospheric Deposition in Sub-Sahara Africa

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ABSTRACT

Air pollution is one of the biggest environmental risks to human health and development, and has been linked to respiratory track malfunction, cardiovascular disorders, metabolic disorders and diabetes mellitus, cancer, blood and blood vessel dysfunction, cognitive disorders, bone demineralisation, visual damage, allergies, reproductive failure and overall disruption of immune system. The World Health Organisation (WHO) report of 2018, showed that Sub-Saharan Africa experiences one of the highest rates of ambient air pollution with particulate matter (PM₁₀ and PM_{2.5}) levels above the guideline limits of 20 µg/M³ and 10 µg/M³, respectively. The actual composition of hazardous chemicals in particulate matter is not fully elucidated. Majority of the existing atmospheric studies in Africa have focused on analysis of basic parameters such as PM₁₀ and PM_{2.5} particles, greenhouse gases, black carbon, and oxides of sulphur and nitrogen. Hazardous chemical contaminants such as organochlorine pesticides (OCPs), Polychlorinated biphenyls (PCBs), Dioxins and furans, Polynuclear Aromatic Hydrocarbons (PAHs), Poly-brominated Flame retardants (PBDEs), polychlorinated naphthalenes, and Per-fluorinated compounds (such as PFOS) in air, which have been associated with cancer, birth defects, reproductive health effects, immunosuppression, respiratory system malfunction, endocrine disruption among other complex illnesses that can adversely affect human health. Data on these chemicals in ambient air from hot spot areas such as municipal dumpsites which are prone to abrupt fire explosions, industrial areas, and urban dwelling areas is largely missing in Africa Region. In addition, the region experiences a big scientific data gap on the extent of composition and speciation of hazardous compounds which require detailed sampling, laboratory sample preparation and analysis; and nutrients deposition in Africa great lakes. Hence the existing policies are not adequate in providing robust management framework to control majority of hazardous chemicals in atmospheric pollution and restoration of

aquatic and terrestrial ecosystems. There is need for scientific data on these chemicals to support formulation of evidence based policies and regulations to mitigate the burden of air pollution on human health and ecosystems restoration. This requires capacity building in terms of personnel as well as building analytical capacities in terms to meet high precision requirements for extraction, clean-up and analysis tools. The work seeks to discuss ongoing effort under the Global monitoring Plan and Equatorial Africa Deposition Network in building capacity for long-term data on composition and speciation of hazardous chemicals in the atmosphere. There is need for strong networking to promote comprehensive assessment of these chemicals in ambient air across Africa region. Management of hazardous chemicals in air in Africa contribute to long-term development strategies like Agenda 2063 and the sustainable development goals on human health, food safety, life on land and under water in Africa.

Key words: Environmental pollution, Persistent Organic Pollutants, Wet and dry deposition, Nutrients,
Equatorial Africa.

Types and Classification of Pesticides Used on Tomatoes Grown in Mwea Irrigation Scheme, Kirinyaga County, Kenya

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ABSTRACT

This study evaluated 403 farmers from the open fields and greenhouses in Mwea Irrigation Scheme on the types and classification of pesticides used to control pests and diseases on tomatoes, in July 2017 to June 2018. Five greenhouse tomato farmers were purposively selected while sample size of 196 open field farmers calculated using Fisher's formula. Cross-Sectional design using a structured questionnaire, face to face interviews and focus group discussions was used to collect data from 201 farmers in the eight wards, Gathingiri, Tebere, Kangai, Wamumu, Murinduko, Nyangati, Mutithi and Thiba. Accuracy of the data was ensured by pre-testing the questionnaire on tomato farmers from a neighbouring Maragua sub-county, errors were corrected and omissions added to the questionnaire. Descriptive statistics was carried out for frequencies, percentages, means, standard errors, variance and data subjected to T-test at 95% Confidence Interval to determine significant differences between variables. Results from the interviews revealed that farmers applied 57 and 12 pesticides under different trade names on tomatoes in the open fields and greenhouses respectively. Pyrethroids, carbamates, nicotinoids, organophosphates, and organochlorines were applied on tomatoes among others. The 20 and 12 pesticides mainly used in open fields and greenhouses were WHO Class II (60%) and WHO Class III (42%), respectively. Farmers heavily relied on different types of pesticides to control a wide range of major pests and diseases such as *Tuta absoluta* and blight respectively. Chlorantraniliprole and mancozeb were the main pesticides used on tomatoes. Most pesticides, WHO toxic class II including pyrethroids and carbamates should be used following manufacturers' recommendations to prevent human health risks. Training and awareness by the Ministry of agriculture, Kirinyaga County government are needed on use of less toxic pesticides equally effective in controlling pests and diseases, such as WHO classes III and IV and bio-pesticides with minimal negative effects on human health

Keywords: Tomato; farmers; pesticides; types; Mwea irrigation scheme; Kirinyaga County.

Farmers' Compliance with Pesticide Use Standards in Mwea Irrigation Scheme, Kirinyaga County, Kenya

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ABSTRACT

Kirinyaga County is the leading producer of tomatoes in Kenya and farmers heavily rely on pesticides to control pests and diseases. The aim of the study was to evaluate the farmers' compliance with pesticide rate and Pre-Harvest Interval standards. The study was conducted in Kirinyaga County at Mwea Irrigation Scheme between July 2017 and June 2018. The study used a Cross-Sectional design that included 203 farmers (198 from open fields, 5 from greenhouses) who grow tomatoes and have used pesticides consistently for at least 2 years. Out of 20 pesticides mainly applied on open field tomatoes, 16 were applied at significantly ($P < 0.05$, 0.01, 0.001) higher rates and tomatoes sprayed with 19 of the pesticides were harvested at significantly ($P < 0.05$, 0.01, 0.001) shorter Pre-Harvest Intervals, than recommended by the manufactures. On the other hand, out of 12 pesticides applied on greenhouse tomatoes, 3 were applied at significantly higher rates, and tomatoes sprayed with 2 pesticides were harvested at shorter durations than specified by the manufacturers. Farmers did not comply with the laid down standards. Non-compliance was due to ignorance, intentional and reliance on neighbor's and their own, information. The study recommends frequent education and training for farmers by Ministry of Agriculture Livestock and Fisheries on safe use of pesticides to help improve on compliance with standards.

Keywords: Farmers; Compliance; Pesticides; Risks; Rate; Pre-harvest time Interval

Acaricides Residue Levels in home cattle sprays, soil and water from Ewaso Nyiro River in Kajiado West Sub-County, Kajiado County, Kenya

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ABSTRACT

The study aimed at determining the residue levels of different types of amitraz, deltamethrin and cypermethrin pesticides used by farmers in Kajiado West Sub County to eradicate ectoparasites in cattle. The parasites are responsible for economic losses that are either direct or indirect in cattle and sheep. Some of the direct losses are as a result of discomfort and damage caused by parasites resulting in drops in milk and damage to wool and hides. Structured questionnaires were also randomly administered to 38 cattle farmers to determine farmers' knowledge on the use of pesticides. Ten farmers who use hand sprays were selected from the study area and samples collected on the spray days. 1.0 L of homemade cattle sprays samples were collected by grab method into amber glass bottles after the farmer prepared the cattle sprays. In addition, 100 g of soil samples were collected (0-30 cm plough layers) for pesticide residue level analysis. Soil samples for dissipation studies were also collected at the sites where farmers sprayed their animals on day 0, 1, 2, 3, 4, 5, 7 and 10. Water samples were collected from the southern tributary of Ewaso Nyiro River in 2.5L amber bottles by grab method. All the samples were collected during the dry and wet seasons. Soil samples were Soxhlet extracted while Water samples and homemade cattle sprays were liquid-liquid extracted with dichloromethane as solvent, cleaned and analysed by gas chromatography-mass spectroscopy at the University of Nairobi, Chemistry Department. The acaricides in homemade cattle sprays detected were amitraz ($12,236 \pm 145.4$ µg/L), cypermethrin (11972 ± 74 µg/L) and deltamethrin ($12,298 \pm 82.1$ µg/L) while the residue levels of these pesticides were below the detection limits (BDL) in all the river water samples. The half-life of amitraz in soil was (0.44-1.6) days, cypermethrin (0.7–3.3 days) and deltamethrin (0.74–1.3 days). The concentration of the homemade cattle sprays ranged from 3.88 ± 0.10 to 12.2 ± 1.45 µg/L for amitraz, 3.83 ± 0.08 to 11.97 ± 0.74 µg/L for cypermethrin and 3.87 ± 0.33 to 12.29 ± 0.82 µg/L for deltamethrin. The analysis revealed that homemade cattle spray in the sub-county had low concentrations of amitraz, cypermethrin and deltamethrin than those recommended by the manufacturers (50-400 µg/L) indicating that the acaricides were over diluted leading to the observed tick re-occurrence. Thus there is need for the agrochemicals and the county government of Kajiado to train the farmers on how to prepare the homemade sprays to ensure efficient tick control. The observed disposal practices of expired acaricides and containers after use 43.3 % burn, 21.7 % dispose in pit latrines while 11.7 % bury underground have great potential to cause environmental pollution and by extension affect human health.

Keywords: Acaricide; Residue; Farmers; water; soil; Kajiado County

Effectiveness evaluation of Bacterial Species Isolated from soil in Bioremediation of Diazinon, Pirimicarb and Atrazine Pesticides

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There is a great concern of pesticides contamination in soil, air, water, food and the environment. Soils are contaminated with pesticides residues due to excessive application of agrochemicals. Removal of pesticides residues is vital for soil and food production. The objective of this research work is to evaluate the bioremediation efficiency for pesticides utilizing bacteria species as source of carbon. Three pesticides namely Diazinon, Pirimicarb and Atrazine and three bacterial species; *E. coli*, *Salmonella* and *Staphylococcus*; isolated from soil were studied for this purpose. Single and different combination of pesticides concentration levels of 10, 25 and 50 ppm were prepared, assayed and tested for pesticides bioremediation with different combinations and concentrations of bacterial species cultured in broth media. Bioremediation of pesticides were calculated in concentration percentage after 24 hours. Results showed that for the three pesticide concentrations 10, 25, and 50 ppm, *Staphylococcus* was highly efficient on Diazinon removal by 62%, 63.2% and 68.6%, respectively; Pirimicarb removal was 44%, 52.4% and 53.8% respectively; Atrazine removal was 61%, 65.6% and 70.6% respectively. Efficiency of *E. coli* removal on Diazinon was 59%, 60.8% and 61.8%; on Pirimicarb was 44%, 52.4% and 53.8%; Atrazine 57%, 60.8% and 64.4%. *Salmonella* efficiency on Diazinon bioremediation was 49%, 51.2% and 55.8%; on Pirimicarb removal was 61%, 63.2% and 68.4, and on Atrazine biodegradation was 48%, 50.4% and 57.2%. Mixture of *Salmonella* and *Staphylococcus* bacteria showed remediation of 64.8% for Atrazine, 74.4% for Diazinon and 75.7% for Pirimicarb. The combined effects of *E. coli* and *Staphylococcus* bacteria resulted in pesticide removal in the following order; Atrazine 66.8%, Diazinon 76.3% and Pirimicarb 77.7%. The combination of *E. coli* and *Salmonella* give rise to 60.3% removal of Atrazine 72.7% for Diazinon and 69.7% for Pirimicarb. When the three species of bacteria mixed together, their combined effect was 83.4% on Pirimicarb bioremediation; 82.0% on Diazinon and 69.1% on Atrazine. The highest significant value of interaction between a mixture of bacteria and pesticides in bioremediation of pesticides was recorded for all bacteria with Pirimicarb and the lowest value was found for *E. coli* and *Salmonella* with Pirimicarb. Results showed cell growth rate of 32.22×10^4 for diazinon, 30.43×10^4 for pirimicarb and 31.43×10^4 for atrazine. *Salmonella* bacteria showed the lower growth rates compared to other species. The rate of growth on diazinon was 21.58×10^4 , pirimicarb 22.89×10^4 and on atrazine 20.71×10^4 respectively. Bacteria efficiency on bioremediation of pesticides from contaminated soil is promising and could be used safely for cleanup, yet more research on mechanisms and kinetics needs to be further investigated.

Heavy metals in farmed and wild milkfish (*Chanos chanos*) and wild mullet (*Mugil cephalus*) along the coasts of Tanzania and associated health risk for humans and fish

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ABSTRACT

2016, farmed milkfish (*Chanos chanos*) from Tanzania mainland (Mtwara), and Zanzibar islands (Pemba and Unguja) and wild milkfish and mullet (*Mugil cephalus*) from the Indian Ocean were collected for analyses of heavy metals (Pb, Cd, Hg, As, Al, Fe, Zn, Cu, Ni, Co and Cr) in muscles and livers. High concentrations of Pb were detected in muscles and livers from wild and farmed milkfish and wild mullet from all sites. The highest concentration of Pb was detected in wild milkfish liver from Mtwara (47.4mg/kg ww). The Pb concentrations in fish muscle exceeded maximum levels (ML) set by FAO/WHO (0.3 mg/kg ww) in 100% of the analysed fish. Concentrations of Pb were higher in wild fish than in farmed fish. Cd concentrations were generally low. The comparison of the Hg concentration with EQS_{Biota} indicated that Hg might pose potential health risk to 22% of the analysed fish. Median concentrations of Fe in livers from farmed milkfish from Jozani and Shakani, Zanzibar, were 40-80 times higher than the other sites. Assessment of human health risk and exposure to heavy metals indicated no potential risk from consuming the fish from the present study locations. However, the Pb concentrations exceeding ML in the fish suggests that Pb may affect the health of fish. Future investigations should include regular monitoring of heavy metals in farmed and wild fish in Tanzania for further development of sustainable aquaculture and the welfare of the wild fish stock in the coastal waters. **Keywords:** Heavy metals, Lead, Aquaculture, Estimated daily intake (EDI), Human health risk, Fish health

Determination of Aflatoxins and Nutritive Levels Associated with *Rastrineobola Argentea* in Selected Localities in Kenya

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ABSTRACT

Kenya's fisheries sector is of high strategic economic value in supporting livelihoods and contributing to food and nutrition security. However, the sector makes less than 1 per cent contribution to the Gross Domestic Product, with fish production mostly dominated by freshwater sources like Lake Victoria as well as aquaculture production. *Rastrineobola argentea* is the second important fish catches after Nile Perch in Lake Victoria. Although its rich in nutrients, huge losses are mainly reported during rainy seasons when sunshine is minimal, large catches are made and hygiene is poor. The major challenge is due to post harvest deterioration as a result of insufficient drying (through sun drying) during this period which results in infestation by fungi that produce secondary metabolites including aflatoxin that are health hazards. There are no studies in Kenya to quantify the aflatoxin associated with *omana*. This study was therefore undertaken to determine public knowledge, diversity and abundance of aflatoxins in sun dried *Rastrineobola argentea* and assess its relationship with the moisture, calcium and iron content in *omana*. To assess the public knowledge, a survey was carried out around Lake Victoria landing beaches in Kisumu, Migori and Siaya counties and fish markets in Nairobi. A total of 252 Samples collected in dry and wet seasons. The samples were blended and sub-sampled for proximate calcium and iron analysis as well as aflatoxin and moisture content determination. Iron and calcium levels were determined using Atomic Absorption Spectrometry. Total aflatoxin quantification using fluorescence detector in High Performance Liquid Chromatography (HPLC) in reverse phase. Determination of moisture content was by Oven from at 130 °C. There was female dominance in fish processing in the study sites. Illiteracy levels was high with majority of the respondents having attained only primary education. Sun drying is the most widely practiced method of fish preservation. There was wide a knowledge gap among the respondents in the study with 65.59 % unaware of aflatoxins contamination and its health implications. Proximate calcium levels in *omana* ranged from 1,872.21 to 2,940.90 mg/kg compared to the recommended adult's daily intake of 1,000 – 1,300 mg. Iron ranged from 5.62 to 15.64 mg/kg. The total aflatoxin detected in singular samples ranged from 0.44 µg/kg – 4.42 µg/kg signifying *omana* aflatoxin contamination. Moisture content in the collected samples ranged from 10.13 to 14.40 %. Hence consumption of *omana* is good for bone formation, maintain skeletal integrity and can overcome anemia due to iron deficiency. Although, total aflatoxin levels in *omana* are within the accepted limits in Kenya, continued consumption can lead to chronic aflatoxicosis that are associated with liver cancer, spontaneous abortion, immunosuppression, micronutrient deficiencies, stunting, neurological impairment and child mortality. Integrating the topic into agricultural and health sciences subjects from as early as from primary school could be much more effective. Good hygiene practices and hazard analysis critical control point should be made operational along the harvesting, processing and distribution line of sun dried *omana* samples to reduce the moisture content as well as the levels of aflatoxin contamination.

Key words: *Aflatoxin contamination, Rastrineobola argentea, Lake Victoria, Open air markets.*

L23

Determination of alkylphenol ethoxylates (APEs) and alkylphenols (APs) in water and sediment from River Benue, North Central Nigeria

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ABSTRACT

In this study, alkylphenol ethoxylates (APEs) including their alkylphenol (AP) derivatives; octylphenol ethoxylate (OPE), nonylphenol ethoxylate (mono-NPE), nonylphenol di-ethoxylates isomers (di-NPE1 and di-NPE2), octylphenol penta ethoxylates (OPPE), nonylphenol penta ethoxylates isomers (NPPE1 and NPPE2), *tert*-butylphenol (*t*-BP), *tert*-octylphenol (*t*-OP), *tert*-nonylphenol (*t*-NP) and octylphenol (OP) were determined in water and sediment samples from River Benue, in the Makurdi Metropolitan Area, North Central Nigeria using gas chromatograph – mass spectrometer. Commercial APEs are of significant research interest due to their extended use in several consumer and personal-care products couple with their ability to mimic natural hormones and disrupt the endocrine system. The samples were collected from the River, bi-monthly, for one year across dry and wet seasons. Most of the compounds considered were found to be present in both water and sediment. The total concentrations of APEs (Σ_8 APEs) in water ranged from 1.56 – 45.92 ngL⁻¹ during dry season and from 0.76 – 27.49 ngL⁻¹ during wet season while in sediment, during dry and wet seasons, it ranged from 15.15 – 45.26 ngg⁻¹ and 2.02 – 27.12 ngg⁻¹ respectively. The results also showed the total concentration of APs (Σ_5 APs) in water in the range of 0.07 – 2.12 ngL⁻¹ and 0.00 – 2.11 ngL⁻¹ during the dry and wet seasons respectively. In sediment, the Σ_5 APs ranged from 0.67 – 1.75 ngg⁻¹ during dry season and 0.10 – 2.90 ngg⁻¹ during the wet season. It was concluded that the result of this study can provide useful reference for further studies on APs and APEs pollution and risk assessment in the river.

Keywords: Gas chromatograph – mass spectrometer, alkylphenol ethoxylates, alkylphenol, sediment, river water

Determination of Gossypol in Hamid and Bt (Seeni 1) Cottonseed Oil using Fourier Transform Infrared Spectroscopy

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ABSTRACT

This study was conducted to determine the gossypol content in Bt cottonseed (Seeni-1) oil by using Fourier Transform Infrared (FTIR) spectroscopy with an Attenuated Total Reflectance (ATR) element. The wavelengths used were selected by spiking refined, bleached deodorized palm oil (RBDPO) to gossypol concentrations of 0-5% and noting the regions of maximal absorbance. Absorbance values of the wavelength regions 3700-2400 & 1900-750 cm⁻¹ and a partial least squares (PLS) method were used to derive calibration models for Hamid cottonseed oil, Seeni-1 cottonseed oil, and gossypol-spiked RBDPO. The coefficients of determination (R²) for the calibration models were computed for the FTIR spectroscopy results against those found by using the wet chemical method AOCS method Ba 8–78. The R² was 0.8916, 0.9581, and 0.9374 for Hamid cottonseed oil, Seeni-1 cottonseed oil, and gossypol-spiked RBDPO, respectively. The standard error (SE) of the calibration was 0.053, 0.078, and 0.062, respectively. The calibration models were validated using the crossvalidation technique within the same set of oil samples. The results of FTIR spectroscopy as a useful technique determining gossypol content in crude cottonseed oil showed that there is a significant difference ($p < 0.05$) in the amount of gossypol content in Hamid and Bt Seeni-1 cottonseed oils.

Keywords: *Bacillus thuringiensis*; Cottonseed oil; FTIR spectroscopy; Gossypol; PLS

Degradation of aflatoxin in maize using Ferulic acid (phydroxy-3-methyl cinnamic acid) catalyzed by Hydrogen peroxide

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ABSTRACT

The study aimed to determine the rate of degradation of aflatoxin in contaminated maize using ferulic acid catalyzed by hydrogen peroxide. 100 g of dried maize grain was grounded using a laboratory hammer mill and divided into 2 portions of 50 g each. 20 g sample was taken per portion and treated with 100 mL solution of methanol and deionized water in the ratio of 8:1, 50 mL of Acetonitrile, 1 g NaCl and 4 g of anhydrous magnesium sulphate, then blended at 120 RPM for 30 min. Aflatoxin content in each extract was analysed using enzyme-linked immunoassay test kits and confirmed using high performance liquid chromatography (HPLC) coupled with fluorescence detector. Further experiments tested the effect of coating, size, concentration, catalyst and reaction time on degradation of aflatoxin in maize. Data analysis was conducted using SPSS and Microsoft excel. Four-hour treatment of contaminated maize with 0.5 mM ferulic acid reduced aflatoxin by 91.0% for whole maize, 90.5% for dehulled maize and 90.9% for ground maize. Addition of 20 mL of 0.5% hydrogen peroxide to the reaction mixtures increased degradation of aflatoxin to 99.0% for whole maize, 99.1% for dehulled maize and 99.1% for ground maize within 4-hour reaction time. The rate of decontamination followed first order kinetics with R^2 values of 0.919, 0.916 and 0.930 for the whole maize, dehulled maize, ground maize, respectively and achieved degradation half-lives of 43.59, 41.26 and 39.84 minutes in the same order. Ferulic acid combined with hydrogen peroxide is an effective degrader of aflatoxin in maize. The rate degradation is dependent on the nature of maize pre-treatment, the concentration of ferulic acid, and the catalyst. Ferulic acid and hydrogen peroxide reacted with the lactone ring of the coumarin moiety of aflatoxin. Further studies on degradation of aflatoxin in maize should elucidate the pathways and metabolites formed in the ferulic acid degradation process and determine their toxicities.

Key words: *Aflatoxin, rate, decontamination, maize, ferulic acid.*

HEAVY METALS CONCENTRATIONS IN NILE TILAPIA FISH (*OREOCHROMIS NILOTICUS*) IN DONGOLA AND MEROWE, NORTHERN STATE, SUDAN

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ABSTRACT

Heavy Metals (HMs) are potentially toxic or carcinogenic even at very low concentration and, can enter the food-chain/web. This study aims to identify and determine the levels the HMs in tilapia fish in North Sudan State (viz. Dongola and Merowe Localities), where the populations complain of high rates of all types of cancer, renal failure, miscarriages, diabetes, etc., and compare them with the international and regional levels. The First part of the study was analyzing data from a report from Dongola Centre for tumor therapy. The laboratory work conducted in the Central Petroleum Laboratories (CPL), Khartoum, Sudan, using Inductively Coupled Plasma– Optical Emission Spectrometer ICP-OES 725 E) instrument to determine Zn, Pb, Cu, Co, Ni, Cd, Mo, Cr, Fe, Li, and Hg levels and compare their concentrations with the national permissible levels (PLs), using the Complete Randomized Design with three replications. Tilapia fish samples collected from the muscles and the liver from the two localities demonstrated the presence of Pb and Ni in muscle tissue (0.481 and 4.023 ppm, respectively), and Pb in liver (0.467 ppm in Dongola. Merowe fish samples emphasized the presence of Pb and Ni in muscle tissues (0.399 and 3.577 ppm, respectively, and in the liver tissue Pb (0.466 ppm). The PLs 0.214 and 0.5-0.6 ppm for Pb and Ni, respectively. It is concluded from our previous studies on the River water and sediments that these are the main sources of these high level is fish.

Keywords: *Tilapia fish, heavy metals, Northern Sudan, Dongola, Merwe*

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Thermodynamics of Cation Exchange-Adsorption in Soil: A Langmuir Modelling Approach

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ABSTRACT

We propose that the "bonding coefficient" or "affinity parameter" of the Langmuir adsorption isotherm, in the context of cation exchange is equivalent to the thermodynamic equilibrium constant (K_{eq}) for the process for homovalent exchange in soil. Therefore, this parameter may be applied as an ion-selectivity parameter for such reactions in much the same way as that calculated using the more usual Gaines-Thomas approach. Following from this, it may also be deployed to calculate the standard free energy change (ΔG°) and other thermodynamic quantities (ΔH° and ΔS°) associated with the exchange adsorption reaction.

Key words: cation exchange; thermodynamics; soil; adsorption; ion selectivity; Langmuir

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Determination of heavy metals Pollution in Haffirs soil: Case Study, Gedarif State, Eastern Sudan

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ABSTRACT

Concentrations of fourteen heavy metals which include: Cu, Fe, Mo, Ni, Cr, Co, V, Sr, Mn, Ti, Ag, cadmium (Cd), lead (Pb), and Zinc (Zn) in soil, were estimated in three different locations in Azaza, Trafa and Elkafay haffirs and three different deeps (surface, 30 and 60cm depth) of Al Gadarif state, Sudan. The soil samples were analyzed for fourteen heavy metals by using Inductively Coupled Plasma Optical Emission (ICP-OE). Is most advanced technique for determination of trace metal concentrations up to 1 part per million (ppm). The pH of the surface, 30cm and 60cm depths soil (Azaza, Trafa and Elkafay haffirs) the value at surface soil (9.14, 9.99 and 9.56) value at 30cm depth (8.32, 9.8 and 9.77) and value at 60cm depth (8.5, 9.83 and 9.53) respectively in the range of alkali. The results for heavy metals show that Fe, Cr, Ni, Pb, Cu, V, Sr. and Ti these highest concentration (ppm) in haffirs in all three locations. The levels of Fe in three different locations and three different deeps at Elkafay haffirs value (65422), (67760) and (69433) ppm was significantly ($p \leq 0.05$) higher than there of Azaza and Trafa haffirs. The Azaza value (53769), (55904) and (57226) ppm the value Trafa haffirs (52454), (50041) and (49633) ppm

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respectively. The levels of **Pb** at Azaza haffir value (120), (103) and (125) ppm, Trafa haffir value (123), (130) and (153) ppm and Elkafay haffir value (123), (113) and (123) ppm respectively. Trafa haffir was significantly ($p \leq 0.05$) higher than these of Azaza and Elkafay haffirs. The levels of **Cu** at Azaza haffir value (123.3), (138) and (124.3) ppm, Trafa haffir The levels Ni at Azaza means concentration (128), (138.7) and (122) ppm and Elkafay haffir value (130), (137.3) and (123) ppm respectively. Azaza haffirs was significantly ($p \leq 0.05$) high than these of Trafa and Elkafay haffirs. The levels of **Cr** at Trafa haffir means concentration (273.5), (263.2) and (228.3) ppm, the Azaza haffir value (133.8), (136.9) and (137.1) and Elkafay haffirs value (269.7), 317.9 and 348) ppm respectively. Trafa and Elkafay haffirs were significantly ($p \leq 0.05$) higher than those of Azaza haffirs). The levels of **Ni** at Azaza haffir means concentration (87.15), (88.62) and (91.64) ppm, Trafa haffir means concentration (115.8), (111.1) and (110.6) ppm and Elkafay haffir value (136.7), (135.3) and (144.4) ppm respectively. Trafa and Elkafay haffirs were significantly ($p \leq 0.05$) higher than those of Azaza haffirs. The levels of **Sr** at Azaza haffir means concentration (1248), (235.1) and (220.6) ppm, Trafa haffir value (297.3), (365.8) and (367.7) ppm and Elkafay haffir value (302), (317.5) and (324) ppm respectively. Trafa and Elkafay haffirs were significantly ($p \leq 0.05$) higher than those of Azaza haffirs. The levels of **V** at Azaza haffir value (156.4), (158.4) and (163.1) ppm, Trafa haffir value V(164.), (154.7) and (154.4) ppm and Elkafay haffi r value (185.9), (196.9) and (207.7) ppm respectively. Elkafay haffirs was significantly ($p \leq 0.05$) higher than these of Azaza and Trafa haffirs. The levels of **Ti** at Azaza haffir means concentration (6350), (6511) and (7035) ppm, Trafa haffir value (7043), (6633) and (6415) ppm and Elkafay haffir means concentration (8709), (8418) and (8581) ppm respectively. Elkafay haffirs was significantly ($p \leq 0.05$) higher than these of Azaza and Trafa haffirs. The concentrations of Fe, Cr, Ni, V, Sr and Ti were higher for soil samples as for three different locations and three different deeps than their permissible higher limits (PLs) according to FAO/WHO (2004) for each haffirs.

Detection of Lead and Cadmium in Human Urine as Bio-indicators of Environmental Pollution in Two Localities (Umelgura and Eastern Gezira) in Gezira State, Sudan

Marwa Mohammed Eisa Eltohami

ABSTRACT

Among toxic heavy metals, lead (Pb) and Cadmium (Cd) rank as the most serious environmental poisons all over the world. Exposure to Pb and Cd at home and work places result in health hazards to both adults and children. This study aims to determine levels of Pb and Cd in the urine among adults (males, females and children; ≤ 5 , 20 samples/sex/village) in two villages (Rigwa and Wadelsid) within two localities Umelgura and Eastern Gezira, respectively, in Gezira State, Central Sudan, and to compare the values with the international and regional limits. The study aims also to trace the sources of Pb and Cd in fresh, cooked and canned food, River Nile and wells water, dust, paints and petroleum derivatives based on the prepared questionnaire. Recorded levels of Pb and Cd were then related to the different professions (farmers, industry workers, drivers, teachers, house wives and others) of the tested groups. The age groups were 15-20, 25-35, 40-50 and 55-65 years old. Data obtained by questionnaire through health centers were used to monitor health conditions in relation to Pb and Cd levels and their sources. Urine samples (total of 160) collected from these groups were analyzed by atomic absorption spectrophotometry (AAS) according to Zinterrhogeret *al.* (1971) method at Shambat Central Laboratory, University of Khartoum, Faculty of Agriculture. A completely randomized design (CRD) was used. The results revealed presence of Pb and Cd in urine with no exception. Detailed results based on gender and age were as follows: Pb levels in urine of females in Rigwa (Umelgura) showed means of 0.343, 0.099, 0.092, 0.138 and 0.200 mg/L (ppm), for ≤ 5 , 15-20, 25-35, 40-50 and 55-65 yr. old, respectively. The levels of males showed means of 0.162, 0.110, 0.103, 0.190 and 0.298 mg/L (ppm), respectively, for the same previously mentioned order of age. On the other hand, Pb levels in urine of females in Wadelsid (East Gezira) reflected means of 0.336, 0.117, 0.211, 0.317 and 0.148 mg/L (ppm), respectively, for five age categories. However, following the same order of age, Pb levels in urine of males registered means of 0.101, 0.049, 0.089, 0.400 and 0.198 mg/L (ppm). Moreover, the means for Cd levels in urine of females in Rigwa were 0.289, 0.113, 0.203, 0.283 and 0.199 mg/L (ppm) for ≤ 5 , 15-20, 25-35, 40-50 and 55-65 yr. old, respectively. The Cd levels of males had means of 0.087, 0.069, 0.288, 0.274 and 0.288 mg/L (ppm), respectively, for the same age groups. Regarding Wadelsid females Cd levels in urine had means of 0.014, 0.020, 0.015, 0.022 and 0.040 mg/L (ppm), respectively, following the same order as above. The means for the males were 0.122, 0.129, 0.051, 0.089 and 0.099 mg/L (ppm) for ≤ 5 , 15-20, 25-35, 40-50 and 55-65 yr. old, respectively. The acceptable limits for Pb and Cd are < 60 and 10 mg/L (ppm), respectively. From the data of the present study when comparing the Pb concentration in all tested age groups in Rigwa and Wadelsaid villages, it is found that a high level of Pb in all ages groups of females, except the oldest group in Wadelsaid village when compared to Rigwa village (55-65 yr-old). On the other hand, there is higher concentration of Pb in males of Wadelsaid village than those of Rigwa village, except age groups of 15-20 yr-old and 25-35 yr old. When comparing the concentration of Cd in all tested age groups in the two villages, the data revealed high concentration in both females and males of Rigwa village than Wadelsaid. All the concentrations of Pb and Cd under the acceptable level. The study recommended that implementation of international

and national polices and establishment of occupational health and safety units (OHSU) in schemes, corporations and factories are of great importance in prevention of environmental health hazards.

Highly Active and Selective Ag-Cu Bimetallic Catalysts Supported on Polyoxometalates and Talc as Catalysts for Sustainable Oxidation of Benzyl Alcohols with Molecular Oxygen as the Oxidant

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ABSTRACT

We report efficient catalytic systems for the oxidation of benzyl alcohols using molecular oxygen as the oxidant and catalysed by bimetallic catalysts supported on polyoxometalates (Ag-Cu/POM) and on Talc (Ag-Cu/talc). The catalysts were prepared by galvanic displacement and reduction, using environmentally benign reagents (polyvinyl pyrrolidone and polyethylene glycol). The catalysts were characterized using a combination of Fourier transform infrared spectroscopy (FTIR), ultraviolet-visible spectroscopy (UV-Vis), powder X-ray diffraction (PXRD), X-ray fluorescence (XRF), Brunauer-Emmett-Teller (BET) surface analysis, transmission electron microscopy (TEM), scanning transmission electron microscopy (STEM), energy dispersive spectroscopy (EDS) and thermogravimetric analysis (TGA). The oxidation reaction was carried out using a Schlenk–line setup under ambient atmospheric pressure. Reaction products were identified by GC-MS and quantified with GC using internal standard method. The Ag-Cu/POM catalyst gave 100 % benzyl alcohol conversion in 5 h with >99% selectivity to benzaldehyde while the Ag-Cu/talc gave the same results in 12 h. When tested on various benzyl alcohol derivatives the Ag-Cu catalysts showed good conversions and >99% selectivity to the corresponding aldehydes. The Ag-Cu bimetallic catalysts supported on the POM are highly stable, and don't show tendency to leach or deactivate. The catalysts are heterogeneous in nature and easy to recover after reactions and could be reused at least 5 times without significant loss in activity and selectivity. The catalysts employ cheap and available materials like copper and talc giving them high potential for industrial application.

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Identification and Determination of concentrations of some Toxic alkaloids in Jimsonweed (*Datura stramonium* L.)

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ABSTRACT

Alkaloids are regarded as complex naturally occurring products of plants, and fungi. They possess nitrogen-containing heterocyclic rings, basic, and derived from amino acids. High physiological activity is also a characteristic of alkaloids. This study was aimed to determine the existence and concentrations of some toxic alkaloids in different parts of jimsonweed (*Datura stramonium* L.). Family: Solanaceae. Stems, leaves and fruits were dried, crushed and then underwent extraction. Solvents used in the extraction were chloroform and acetic acid. Thin layer chromatography (TLC) and GC-MS techniques were also adopted for analyzing the alkaloids. The results revealed that, the presence of atropine, in stems, leaves and fruits of *D. stramonium* with concentration of 0.03, 0.4 and 0.08 µg/g, respectively. Hyoscyne was also found in stems, leaves and fruits with concentration of 0.01, 0.02 and 0.2 µg/g respectively. Nicotine was found in stems and fruits with concentrations of 0.001 and 0.02 µg/g, respectively. This study has opened new horizons to explore new natural potential pesticides from Sudanese indigenous plants and provide important information to avoid toxicity, harmful and adverse effects of these plants to both humans and animals.

Key words: Alkaloids; Solanaceae; Jimsonweed; GC-MS techniques; Nicotine; Atropine

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Suggested Indicators for Measuring Crop Stress

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ABSTRACT

Plants/crops are frequently exposed to biotic and abiotic unfavorable or even adverse conditions, such as salinity, drought, heat, cold, flooding, heavy metals (HM), ozone, UV radiation, insects, diseases, insecticides, herbicides, fungicides, etc. and thus these conditions might pose serious threats/ stresses to the growth, development and yield quantity and quality. These stresses might result in molecular, biochemical, and physiological changes. Oxygen importance for life of plants is well documented, however, on the other hand, oxygen challenges them through an endless formation of reactive oxygen species (ROS), e.g. singlet oxygen (¹O₂), superoxide (O₂^{•-}), hydrogen peroxide (H₂O₂) and hydroxyl radical (OH•). ROS are extremely reactive in nature, because of their ability to interact with a number of cellular molecules, including metabolites, thereby leading to irremediable metabolites that might lead to plant death. Plants have remarkable enzymatic and non-enzymatic detoxication systems that could be able to repair the injurious effects of ROS with the help of enzymes like superoxide dismutase (SOD), catalase (CAT), ascorbate peroxidase

(APX), monodehydroascorbate reductase (MDHAR), dehydroascorbate reductase (DHAR), glutathione reductase (GR), glutathione-S-transferase (GST), glutathione peroxidase (GPX) and peroxidases, alongside with non-enzymetic compounds, e.g. ascorbate (AsA), glutathione (GSH) and tocopherols.

ROS in plants cell are mainly, according to the literature, causing lipid peroxidation, and protein oxidation generating proline and, hence, leading to DNA and RNA damage. Several studies have shown that exposing plants to stress resulted in increases of lipid peroxidation, viz. producing malondialdehyde (MDA), proline and H_2O_2 , alongside with increasing the methyl glyoxal (MG).

Therefore, it is suggested that in case of chemical plant stresses, e.g. HM, pesticides, salinity, and other pollutants, the best indicators to be used for measuring the intensity of each stress are MDA, proline, hydrogen peroxide, AsA, and GSH. The detailed methods for these will appear in the text. For more understanding of the mode and site (mechanism) of the stress one can resort to investigating the activity of the following enzymes: SOD, CAT, APX, MDHAR, DHAR, GR, GST, and GPX.

Keywords: biotic stress; abiotic stress; ROS; Antioxidants; enzymes

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Assessment of Air Pollution and Related Health Effects in Densely Populated Communities in Nairobi County, Kenya (M. Sc. Proposal)

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ABSTRACT

Air pollution is one of the major environmental issue globally and Sub Saharan Countries has its effects more adverse. It can cause adverse health effects such as cancer, cardiovascular diseases and high mortality rates and also to the environment through climate change and global warming. High population density is a huge contributory factor of air pollution in cities and urbanized areas. Most of the Urban population is concentrated in the Slums where the poverty levels are high. Use of unclean fuels for cooking and lighting leads to release of pollutants such as Particulate Matter ($PM_{2.5}$), Black carbon and Carbon Monoxide which is common in slums. Due to limited quantification on the air quality in Sub Saharan countries, it has created a gap for researchers to fill in. Research on the assessment of the levels of these pollutants is paramount to aid in the development of policies and control measures to reduce its health effects. Densely populated communities in Nairobi, Kenya are the most exposed population to the deleterious effects of air pollution due to their close proximity to the industries characterized by emission of harmful pollutants, heavy commercial vehicles releasing hazardous emission, use of dirty fuels for cooking and lighting, uncontrolled burning of wastes in slums and location close to dumpsites. The study is therefore aimed at determining the levels of $PM_{2.5}$, Black Carbon and CO in the mapped sites of the densely populated community and obtaining the health data records from the health centers for correlation with the health effects of air pollution. The data will be compared with a control site. Sampling will be done during the rainy and dry seasons. $PM_{2.5}$ will be sampled using Harvard impactors using the preconditioned filters and analyzed using gravimetric method. Black carbon

and CO will be sampled using MA 200 black carbon portable monitor and CO portable monitor respectively. The data obtained will be compared with the WHO pollutants recommended levels. This study therefore will provide an overview of the levels of the pollutants in the densely populated settlements in Nairobi and will guide the government in the control of the emissions of pollutants and help to maintain clean environment free from pollutants.

Key words: Air pollution, hazardous emissions, human health effects.

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Determination of Polynuclear Aromatic Hydrocarbons in Selected Sites in Nairobi Metropolitan Area (MSc. Proposal)

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ABSTRACT

Polynuclear aromatic hydrocarbons (PAHs) are compounds composed of two or more fused aromatic hydrocarbons. Research shows that about 100 species of PAHs have been identified practically. Anthropogenic and natural processes are the major sources of PAHs in the environment. Human beings get exposed to PAHs through inhalation of air and dust particles suspended in the air or through the skin when in contact with already contaminated dust and soil. However, PAHs are highly carcinogenic and mutagenic compounds and are widely associated with adverse health effects such as liver, skin, and lung cancer.

This work will focus on determining the composition and levels of PAHs in ambient air, soil and water within different areas of Nairobi Metropolitan area. Soxhlet extraction will be used to extract soil and air samples while water samples will be extracted using solvent –solvent extraction. The extracts will be cleaned up, concentrated then analysed by GC-MS. The data will inform policy and contribute significantly to improved environmental management of industrial activities and solid waste within the Nairobi Metropolitan area.

Keywords: Environmental pollution; PAHs; anthropogenic sources; mutagenic; carcinogenic; GC/MS analysis.